



More twists on optical twisters: of helico-conical beams, superpositions and combinations

Glückstad, Jesper; Palima, Darwin

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Second International Conference on Optical Angular Momentum

3 – 5 June 2013

The Burrell Collection, Glasgow, UK

icoam2013.iopconfs.org

Image: Light profile with modal contributions of 2, 0, 1 and 3 units of orbital angular momentum;
overlay of Rodin's The Thinker, as displayed at the Burrell Collection.



combination with a beam-copying technique. Following this, we rotate the polarization of the OAM mode to be weakly measured by a small angle. After a strong measurement of angular position, the OAM weak value is obtained by measuring the changes in the photon polarization.

Using this method, we are able to directly obtain the probability amplitudes of a pure quantum state up to a dimensionality, $d=27$. More significantly, our method allows us to coherently measure the effect of rotations on a quantum state in the natural basis of OAM. Our work has strong applications in the field of quantum information as well as implications for foundational quantum mechanics.

Real-time imaging of quantum entanglement

R Fickler, M Krenn, R Lapkiewicz, S Ramelow and A Zeilinger

University of Vienna, Austria

Photonic entanglement of spatial modes is routinely studied in many experiments and offers interesting features for quantum optical and quantum information experiments. To investigate the properties of these complex modes, it is crucial to gain information about the transversal structure with high precision and in an efficient way. We show that modern technology, namely triggered intensified charge coupled device (ICCD) cameras are fast and sensitive enough to image in real-time the effect of the measurement of one photon on the spatial mode of its entangled partner photon. We determine from an imaged intensity pattern the number of photons within a certain region, evaluate its error margin and thereby quantitatively verify the non-classicality of the measurements. In addition, the use of the ICCD camera allows us to demonstrate visually the enhanced remote angular sensing and the high flexibility of our setup in creating any desired spatial-mode entanglement.

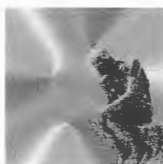
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More twists on optical twistors: of helico-conical beams, superpositions and combinations

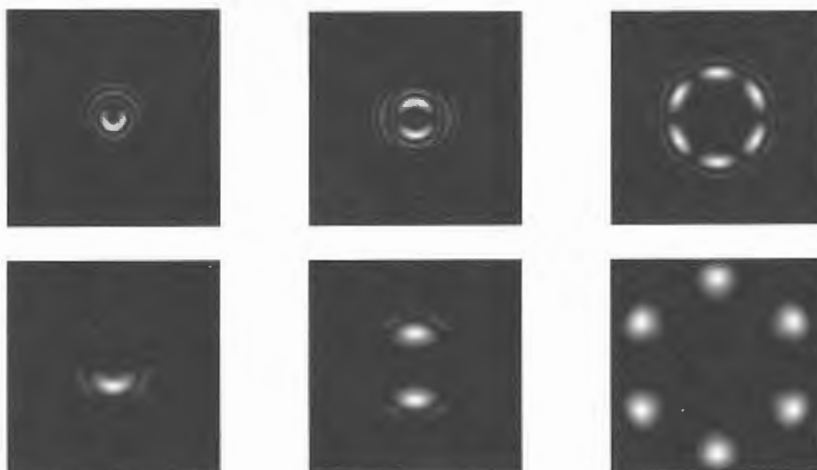
D Z Palima and J Glückstad

Technical University of Denmark, Denmark

We have previously demonstrated so-called optical twistors that can steer microparticles along spiral trajectories during optical micromanipulation^{1,2}. These optical twistors may be created using Fourier holograms of the helico-conical form, $\exp[i l \Theta (K - r/r_0)]$, which is characterized by non nonseparable helical or azimuthal phase and the conical or radial phase³, and that have been shown to self-reconstruct after an obstruction⁴. In this work, we deconstruct the helico-conical beam (HCB) as a coherent superposition of Bessel-like beams, which carry arbitrary topological charge. From this perspective, the HCB is seen as belonging to a generic family of beams that can be generated using this type of superposition. Controlling this superposition enables us to generate tailored spiraling beams. We show different examples of such tailored beams, such as multi-helico-conical beams (i.e., helico-conical beam with selectable number of multiple helix) as well as multihelical beams that emulate the diffractionfree properties of its constituent Bessel-like beams.



Second International Conference on Optical Angular Momentum



Focal plane intensity distributions for different multihelical beams. The beams trace multiple helices as they rotate about the optical axis during propagation.

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